PATENT SPECIFICATION

DRAWINGS ATTACHED

884,446

Date of Application and filing Complete Specification: Jan. 3, 1958.
No. 347/58.
Application made in Austria on Jan. 4, 1957.
Application made in France on Jan. 12, 1957.
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COMPLETE SPECIFICATION

Improvements in and relating to the Heat-Treatment of Metals

ERRATUM

SPECIFICATION NO. 884,446

Page 1, In the heading, *for* "France" *read* "Austria"

THE PATENT OFFICE,
24th February, 1967

D 80596/17

PATENTS ACT, 1949

SPECIFICATION NO. 884,446

In accordance with the Decision of the Superintending Examiner, acting for the Comptroller-General, dated the 20th day of December, 1966 this Specification has been amended under Section 14 in the following manner:-

Page 1, line 38 and Page 3, line 14, *after* "by" *insert* "abruptly"

Page 1, line 39 and Page 3, line 15, *after* "then" *insert* "abruptly"

Page 1, line 42 and Page 3, line 18, *delete* "at least"

THE PATENT OFFICE,
24th February, 1967

D 80596/4

which must be removed by a tempering treatment.

According to the invention there is provided a method of heat-treating a ferrous metal workpiece, normally non-austenitic at room temperature, by heating to above the critical point and then quenching, characterized in that the heating and quenching are effected at such a rate that an austenitic structure is retained in at least the surface portion of the treated workpiece.

This austenitic structure, which in other cases is stable only at elevated temperatures, can be retained in the workpiece in large quanness of the workpiece after the stress treatment can be controlled by suitably varying the working conditions, for example the initial hardness of the workpiece, its carbon content, its content of alloying constituents, the velocity of the tool and/or workpiece, the pressure between the tool and the workpiece, the feed rate, and the time of treatment.

An advantage of the method of heating successive fractional surface portions of the workpiece is that the underlying material of the workpiece can be previously subjected to any desired heat treatment without being affected by the subsequent treatment of the

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COMPLETE SPECIFICATION

Improvements in and relating to the Heat-Treatment of Metals

I, HEINRICH BLECHNER, of Austrian nationality, of 1/12a Jauresgasse, Vienna III, Austria, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a method of heat-treating ferrous metal workpieces, and to articles thus treated.

It is usual to machine or work workpieces with various tools. Tools are known which are used for dividing or cutting only in virtue of their high cutting speed. This gives rise to irregular hard portions at the cut surfaces and it is necessary to remove these hard portions before the subsequent processing of the workpiece. In order to increase the wear resistance of the usual workpieces a surface treatment is adopted. All these operations require a great expenditure of labour, time and energy. The results, particularly those achieved in heat-treating relatively small workpieces, are often fairly irregular. For this reason it has been attempted to effect the heat treatment of the workpieces more quickly and more uniformly in automatic hardening plants, which may be gas-fired or high frequency- or resistance-heated and to which the workpieces are fed immediately after machining. In all these methods of hardening, the quenching treatment gives rise to dangerous internal stresses, which must be removed by a tempering treatment.

According to the invention there is provided a method of heat-treating a ferrous metal workpiece, normally non-austenitic at room temperature, by heating to above the critical point and then quenching, characterized in that the heating and quenching are effected at such a rate that an austenitic structure is retained in at least the surface portion of the treated workpiece.

This austenitic structure, which in other cases is stable only at elevated temperatures, can be retained in the workpiece in large quantities, for example, up to 98%, at room temperature, but is immediately transformed into an extremely hard and tough structure, by subjecting the treated workpiece to stress. The stress can be caused by mechanical shock, for example shaking, impact or by use of the workpiece itself, or by temperature, electrical or other influences. The hardened structure thus produced has only low internal stresses and for this reason does not split or crack and remains firmly bonded to the underlying structure of the workpiece.

According to a feature of the invention successive fractional surface portions of the workpiece are heated to above the critical point and then quenched substantially simultaneously. The quenching can be effected by dissipation of heat into the surrounding material.

A preferred method of heating the successive fractional surface portions is by friction caused by rapid rotary relative movement between the workpiece and a tool, for example a rapidly rotating steel disc. When the invention is carried out in this manner the tool can be so formed as to impart a desired form to the workpiece.

The surface layer of a workpiece treated and hardened by the method of the invention has a uniform smoothness and thickness which remain constant under constant operating conditions. The thickness of the austenitic layer produced on the workpiece and the final hardness of the workpiece after the stress treatment can be controlled by suitably varying the working conditions, for example the initial hardness of the workpiece, its carbon content, its content of alloying constituents, the velocity of the tool and/or workpiece, the pressure between the tool and the workpiece, the feed rate, and the time of treatment.

An advantage of the method of heating successive fractional surface portions of the workpiece is that the underlying material of the workpiece can be previously subjected to any desired heat treatment without being affected by the subsequent treatment of the

surface layer. For example a core of particularly high elasticity can be provided with a surface layer of particularly high hardness and wear resistance, which surface layer is firmly bonded to the core and does not peel off or detach.

A tool suitable for use in carrying out the present invention has been found to be a steel disc rotated at a peripheral speed of at least 80 m./sec. It is of advantage to use a disc having a smooth, ground, preferably polished or honed working surface. The tool found most suitable is a steel disc 100 mm. in diameter and having an edge bevelled at an angle of 45°. However it is also possible to use many other tools such as plain or profiled tools in the form of discs, rolls, cones or balls.

The method of the present invention may be combined with the method of performing shaping treatments similar in effect to milling, reaming profiling, spinning, trueing, grinding, press-polishing, honing and lapping, as described and claimed in the Specification of the co-pending British Patent Application No. 22514/61 (Serial No. 884,447). In this way surface layers having a high finish and an extremely high hardness may be produced on cutting parts of knives or surgical instruments on toothed wheels, bevel wheels, spur gears, worm wheels and spiral gears and on the points of needles and of shafts.

The maintenance of the tools used in the method of the invention is particularly simple and inexpensive. The tool can be heat-treated, or heat-treated and shaped, by means of a second tool moving relatively to the first-mentioned tool. This treatment can be performed by hand or semi- or fully automatically, and can be controlled to temper, grind and/or polish the tool and provide it with an extremely hard layer. The operation may be performed continuously or periodically while the tool itself is in operation. Tools having polished surfaces can be used to produce on the workpiece a particularly thin hardened layer (0.001 mm. or less) having a particularly high surface finish.

Tools which are stationary in operation may be periodically treated for a short time according to the method of the invention with a tool rotating at high speed, and tools which rotate in operation can be treated with a stationary tool for example a hardened and tempered steel rod held against the tool.

A specific embodiment of the invention will now be described in the following Example, reference being had to the accompanying drawing which illustrates the heat-treatment of a shaft.

Example

Surface treatment of round shaft, 5 mm. in diameter

Absolute speed of tool	120 meters/sec.
Feed rate of tool	0
Pressure between tool and workpiece	slight pressure
Absolute speed of workpiece, driven by tool	100,000 r.p.m.
Initial hardness of workpiece (micro-hardness under a load of 25 grams/sq. mm.)	800 kg./sq. mm.
Carbon content	0.9 — 1.1%
Micro-hardness under a load of 25 grams/sq. mm. after the treatment	1100 kg./sq. mm.
Thickness of hardened layer	0.01 mm.

As shown in the drawing the shaft 10 is rotatably carried between centres 11 (only one of which is shown). The shaft is contacted by a rotating steel disc 1 as shown in the drawing whereby the shaft is rotated. The successive surface portions of the shaft contacting the disc are abruptly heated to above the critical temperature and are then abruptly quenched into the surrounding material of the shaft. The quenching is also assisted by the tool which remains cold and/or the current of cold air entrained by the tool so no additional coolant is required for the quenching. As a result of the abrupt heating of the fractional surface portions of the shaft on contact with the tool and the equally abrupt quenching of said portions an austenitic structure is retained in the treated surface of the shaft. This austenitic structure is transformed into a hardened structure by the action of stress. It is not

possible to determine the hardness of the austenitic layer since the pressure of the diamond brings about the transformation to the hardened structure.

The thickness of the hardened surface layer depends on the working pressure between the tool and the workpiece.

It is emphasized that the example can be carried out using a simple tool rotating at high speed.

WHAT I CLAIM IS:—

1. A method of heat-treating a ferrous metal workpiece, normally non-austenitic at room temperature, by heating to above the critical point and then quenching, characterized in that the heating and quenching are effected at such a rate that an austenitic structure is retained in at least the surface portion of the treated workpiece.

2. A method as claimed in claim 1, wherein the austenitic structure is converted into a hardened structure by subjecting the workpiece to stress.

3. A method as claimed in claim 2, wherein the workpiece is subjected to mechanical shock.

4. A method as claimed in any of claims 1 to 3, wherein successive fractional surface portions of the workpiece are heated to above the critical point and then quenched substantially simultaneously.

5. A method as claimed in claim 4, wherein each fractional surface portion is quenched by dissipation of heat into the surrounding material.

6. A method as claimed in any of claims 1 to 5, wherein the heating is effected by friction caused by rapid relative movement between the workpiece and a tool.

7. A method as claimed in claim 6, wherein the tool is a rapidly rotating steel disc.

8. A method as claimed in claim 7, wherein the steel disc rotates at a peripheral velocity of at least 80 m./sec.

9. A method as claimed in any one of claims 6 to 8, wherein the tool has a smooth, ground, preferably polished or honed working surface.

10. A method as claimed in any one of claims 6 to 9, wherein the tool, while it is working, is itself heat-treated, or heat-treated and shaped by means of a second tool moving relatively to the first-mentioned tool.

11. A method as claimed in claim 7 or claim 8, wherein the quenching is assisted by the tool which remains cold and/or a current of air entrained by the rotating disc.

12. A method of heat-treating a ferrous metal workpiece, substantially as hereinbefore described with reference to the specific Example.

13. Heat-treated articles whenever produced by a method as claimed in any of claims 1 to 12.

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884,446 COMPLETE SPECIFICATION
1 SHEET This drawing is a reproduction of the Original on a reduced scale.